Principles of Cleaning and Sanitation

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AVOIDING RECALLS – MANAGING FOOD SAFETY RISKS IN CITRUS PACKINGHOUSES
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The Birko Story

60 Years of Success

• Founded in 1953, Birko is a 3rd generation family-owned manufacturer of cleaning and process chemistry for food producers

• Chad Equipment, LLC, a Birko company, is a leading supplier of equipment for pathogen intervention and chemical handling

• **PMA Gold Circle Member**

• **ColoradoBIZ Magazine Top Manufacturing Company 2013**
Who Do We Work With?

Customer base includes leading food and beverage producers:

- Crunch Pak
- Country Fresh
- JBS
- Tyson
- Cargill
- Tyson Foods, Inc.
- New Belgium Brewing
- Stone Brewing Co.
Our Approach to Food Safety

MULTIPLE-HURDLE INTERVENTION STEPS

• Effective Cleaning & Sanitation Products and Procedures

• Products and Equipment to Control Contamination in the Processing Environment

• Use of Antimicrobial Intervention Products Applied Directly to Product at Key Steps in the Production Process
QUESTION

What is the purpose of cleaning and sanitation?
The “Why?” of Sanitation

Prevents Foodborne Illness

• Regulations tell us we have to - FSMA, FDA etc.
• Risk Management Issue
  • Product Liability
  • Personal Liability
• Brand Reputation

*Effective sanitation is the cornerstone of quality*
Sanitation Safety (i)

• Heavy soil loadings require strong chemicals and high temperatures!
• Learn about the products and risks – train team members
• Chemical damage to the body starts by
  (1) Skin contact
  (2) Absorption through the skin (HF, DMSO)
  (3) Inhalation
  (4) Eye contact
  (5) Ingestion
• Make sure that Safety Data Sheets (SDS) are available to all employees
Sanitation Safety (ii)

- Always wear appropriate PPE (Personal Protective Equipment)
  - Gloves, Safety Glasses, Goggles, Face Shield, Boots, Rain suit
  - Label all buckets and tanks to avoid mixing incompatible chemicals

LOCK OUT TAG OUT

- De-energize, lock & tag out all energy sources on processing equipment
  - Electrical, hydraulic, pneumatic and water/chemical
- Use waterproof covers on electrical boxes and moisture sensitive equipment.
What are we doing during sanitation

- Remove Soil
- Kill Bacteria
- Remove Biofilm
SOIL

- Definition:
  - Any substance that is found on a surface but is not an intended part of that surface and therefore is unwanted;
  - Any substance that is suspended in air and may deposit on a surface but is not intended to be present there

- Synonyms: Dirt, Contamination, Biofilm

- Produce Plant Soils Include: Dust, mud, grime, manure, mineral deposits, protein, carbohydrates, rust

- SOIL harbors, and provides food for, microorganisms
BIOFILM

- Major area of concern for food processors especially for ready to eat items in wet processing areas
- Typically resistant to conventional cleaning and sanitation processes
- Frequent culprit where persistent bacterial contamination is a problem
- Very common in drains
- Specialty products required for removal
Biofilms

- Bacteria attach themselves to surfaces in moist, temperature-permissive environments and begin forming colonies.
- As these colonies grow they produce a protective, adhering matrix which may repel cleaning chemicals and sanitizers.

Before Treatment

After Treatment
Biofilms

- Biofilms are a leading source of bacteria in the food plant environment because of the presence of moisture.
- Many of the problem bacteria such as *Listeria* and *Salmonella* readily produce biofilm protected colonies.
- Not removing the biofilm means that colonies continue to produce more bacteria, releasing them into the plant.
- “Most general cleaning and sanitation products will not penetrate or detach the sturdy polysaccharide biofilm matrix.”
QUESTION

What are the pre-requisites for an effective sanitation program
Prerequisites

TO CLEAN SUCCESSFULLY YOU NEED:

• Knowledgeable Supervision & Management Commitment
• A Cleanable Plant and Cleanable Equipment
• An Operational Cleaning and Sanitation Program
• Adequate Supply of Potable Hot Water Suitable, Functioning Sanitation Equipment
• Effective Cleaning Chemicals and Sanitizers
• Adequate Numbers of Trained Personnel
• Ongoing Employee Training in Sanitation and Safety
SUPERVISION & MANAGEMENT

- Cleaning is a Key Management Responsibility
- Teamwork is key & needs to involve:
  - Management
  - Sanitation Department
  - Maintenance Department
  - QA/QC
  - Production

_All departments and personnel must understand and believe in the importance of effective cleaning and sanitation_
CLEANABILITY

- Materials of construction
  - Stainless Steel and some plastics
  - Aluminum and other soft metals
  - Wood other porous materials
• Sanitation Plan
• What you clean
• When you clean it - Frequency
• How you clean it
  – Disassembly (?), Products, Dilution rates
• Verification
• Sanitation step = product, ppm, contact time
Water Quality Considerations

- Water needs to be potable
- Water Chemistry can have a profound effect on cleaning!
- Plant water should be analyzed for:
  - Hardness - both Ca & Mg – reacts form soap scums
  - Silicates
  - Iron
- Some water conditioning may be required
- Water Chemistry can vary seasonally & by source
- Retest or review annually
Temperature and Pressure

- 130F to 140F adequate for most cleaning applications
- Check temperature at point-of-delivery
- Hot, hot is not better! Excessively hot water can cook proteinaceous material on to surfaces
- New technologies make maintaining a consistent supply of hot water, simple and efficient
- Sufficient pressure to dislodge gross soils
- Sufficient pressure to support the number of hoses in use
- Above 160 psi pressure will *atomize* material into the air
Sanitation Equipment

- Sprayers and Hoses
- Plant pressure should be sufficient
- <160 psi to avoid atomization
- Temperature Setting optimum = 130° F to 140° F
- Adjustable spray pattern
- Water saving designs
- Pressure Washers for field
Equipment – Foamers

- Portable
- Wall-Mounted
- Centralized Systems
  - High Efficiency
  - Reduce Water Use
  - Reduce Chemical Use
  - Speed Up Cleaning Process
  - Save Labor
CHEMISTRY

Cleaning Agents

- Acid Cleaners
- Alkaline Cleaners
- Caustic Cleaners
- Chlorinated Caustic Cleaners
- Neutral Cleaners
- Solvent-Based Cleaners
- Combination Cleaners (Blend On-Site)
Selecting Cleaners

• Soil to be removed
• Substrate
  ➢ Stainless steel
  ➢ Softer metals
  ➢ Plastics or synthetic
  ➢ Porous materials
Mechanisms of Cleaning

**Primary**
- Hydrolysis
- Dissolution
- Displacement/Dispersion
- Emulsification

**Supplemental**
- Peptizing
- Chelation
- Buffering

(For detail, please see Appendix)
Detergent Components

- Surfactants and Wetting Agents – aid soil penetration, emulsification
- Builders – improve surfactant performance by lessening water hardness (chelators)
- Solvents – help dissolve or disperse fatty soils
- Corrosion Inhibitors – protect substrate surfaces from adverse effects of acidic, caustic and chlorinated cleaning compounds
Surfactants

Surfactants Reduce Surface To Promote Wetting and Emulsion Formation

Water + Oil \Rightarrow Oil Globules in Water (2 Phases)

Water + Oil + Surfactant \Rightarrow Emulsion

http://www.silviamar.com/Documents/ssoap.htm
WHAT ARE THE ACTUAL STEPS IN THE CLEANING CYCLE
CLEANING PROCESS

Dry Clean-Up / Dry Pick-Up ("Rough clean")
Remove all product and packaging materials
Sweep, scrape, scoop all gross soil

Pre-Rinse / Rough Down Rinse / Wash Down
Top to bottom
Perimeter toward the center
Inspect – is area ready for foaming
Cleaning Process

Chemical Cleaning
  Foaming application
  Hand Scrub

Rinsing - removes the cleaning chemicals before they dry

Inspection of cleaned surfaces – re-clean if needed

Sanitizing
  Application of an approved compound to kill bacteria
CIP Cleaning

• CIP (Clean-In-Place) – applicable to juice producers
• Enclosed tanks and pipe work are cleaned using the system’s own circulating pumps or an external CIP system.
• Low-foaming cleaners and sanitizers are used
• Follows the same general steps outlined above
• The CIP process may be fully automated on larger systems
Situations to avoid

- Use of high pressure water, air - aerosols
- Inattention to door seals, gaskets, o-rings
- Standing water or drain backups
- Hollow rollers, crannies, nooks
- Mops and foam pads (any multiple use cleaning aids)
- Porous surfaces that can soak up liquids
- Joints, “sandwiches” on equipment
- Spaces inaccessible to sanitation procedures
- Inattention to ventilation systems
- Excessive humidity
Manual Cleaning Failure
Effective Cleaning is 99% of the sanitation job. The remaining 1% is the job of sanitizers.
Produce Bacteria

- *Listeria* spp.
- *Salmonella* spp.
- *Escherichia coli*

*Organic vs. Conventional Process and Product will impact choice of sanitizers*
TERMINOLOGY

Sanitizers and Sanitizing

Sanitizers are not disinfectants.

- Sanitizers kill most bacteria present (5 Log Reduction = $10^5$ down to 1)
- Post Rinse sanitizers – used on food contact surfaces without a subsequent rinse
- Disinfectants kill nearly all bacteria present (6 Log Reduction = $10^6$ down to 1)
- Sterilization kills **ALL** bacteria present
Hard Surface Sanitizers

- Chlorine / Sodium Hypochlorite
- Quaternary Ammonium Compounds ("Quats")
- Iodophors
- Peroxyacetic Acid ("PAA")
- Ozone
- Electrolyzed Water
- Acidified Sodium Chlorite (ASC)/Chlorine Dioxide
Use Precautions

• Sanitizers should be precisely mixed to an application concentration to meet predetermined requirements as defined in your SSOPs

• Under-mixing or over-mixing can be problematic

• Sanitizers are applied after the cleaning rinse step, usually with a low-pressure spray applicator. All surfaces of equipment and environmental surfaces to be sanitized are wetted

• Contact Time!
Use Precautions

• “Post-Rinse Sanitizers” are allowed to remain on equipment and other surfaces without rinsing.

• The label will specify a minimum amount time necessary for sanitizing.

• Visibly wet sanitizer remaining on food contact surfaces may require removal prior to the shift start.
Many Challenges

- Uncontained environment – exposed to the elements
- Wild flora and fauna
- Limited sanitary facilities – bathrooms and hand washing facilities
- Materials not amenable to cleaning
- Temporary transient labor pool not invested in sanitation program
- TIME – Do I Harvest or Do I Clean?
High Risk Areas
Field/Harvest Operations

Suggested Solutions

• Provide hand and equipment washing facilities
• Supervise their use especially after bathroom use
• Mandate cleaning between lots/field areas
• Power Wash and Sanitize harvest equipment between lots/fields and nightly
• Use off season to deep clean equipment
Field/Harvest Operations

Chemistry Considerations

- Non-stainless steel, soft metal and porous surfaces
- Paint, seal or replace where possible
- Mild non-caustic detergents
- Cleaning is key as proper sanitation may be difficult
- Peracetic acid as principle sanitizer
- Fogging an option of the off season
PACKING SHEDS

Many Challenges – Similar to Field

• Relatively Uncontained Environment – open barn with roof but no side walls
• Not built with sanitation in mind
• Pest Control – insects, birds, rodent vectors
• Limited sanitary facilities – bathrooms and hand washing facilities
• Materials not amenable to cleaning
• Temporary transient labor pool not invested in sanitation program
• TIME – Do I Harvest or Do I Clean?
Suggested Solutions – short term

- Pest Control – repel, barriers, traps
- Provide hand and equipment washing facilities
- Supervise their use especially after bathroom use
- Mandate cleaning between lots
- Develop appropriate SSOPs and use them between lots/fields and nightly
- Use off season to deep clean
- Protect packaging materials from contamination
PACKING SHEDS

Suggested Solutions – Long Term

• Remodel or rebuild with a sanitation focus
• Eliminate hard to clean or porous materials
• Build in pest control pest exclusion strategies
• Use off season to deep clean
PACKING SHEDS

- Non-stainless steel, soft metal and porous surfaces
- Paint, seal or replace where possible
- Mild non-caustic detergents
- Cleaning is key as proper sanitation may be difficult
- Peracetic acid as principle sanitizer
- Fogging an option of the off season
Discussion and Questions

www.birkocorp.com
Hydrolysis

“Breaks compounds apart by reaction with water”

- Caustics and acids with extreme pH
- Extreme pH can be corrosive to soft metals (brass, galvanized surfaces)
- **Dissolution**

  "D dissolving soil from a substrate into a liquid to form a solution."

  - Dissolving the soil through whichever means works best - water, solvents, like or opposite pH).
  
  - An example of dissolution is removing hard water scale with acid. The calcium does not change, just dissolves.
Produce Cleaning and Sanitation (reference)

- Displacement/Dispersion

“Penetrates between the soil and substrate and lifts the soil off suspending it in water”

- Alkaline, non-caustic products use displacement by suspending the soil in solution.
- Frequently employ peroxide chemistry to lift soils from the surface
- Dispersing agents keep the soil in suspension to aid rinsing
- Emulsification

“Dispersing oil in water”

- Surfactants (detergents) pull greasy, oily soils into water and keeps them there

- Peptization (opposite = “flocculation”)

“Breaks soils into smaller pieces.”

- Necessary in recycled solutions to keep soil from re-depositing on the surface.
- Phosphates help peptize soil.
- Chelation/Sequestration
  - Chelators complex metal ions (EDTA, heptonate, phosphonates)
  - Help to mitigate the effect of hard water on cleaning chemicals

- pH Buffering
  “Stabilize the pH of cleaning solutions by neutralizing any added acid or alkali.”
  - Holds the pH where you want it to be.
  - Extends the effective life of cleaning solutions
Dry Pick-Up

- Gets all large scrap material off tables, belts and floors
- Squeegees and shovels are used to collect material and place it in “inedible” barrels.
- Wash Down
  - Water sprayers are used to remove material from all surfaces and move it to a collection point.
  - Excessively hot water can cook residues onto equipment surfaces.
  - Our target water pressure is <160 psi.
- Wash Down

• Work systematically from top-to-bottom and from the perimeter of the room toward a drain or central collection point.

• Squeegees and shovels, identified for cleaning purposes only, are used to pick up larger deposits to facilitate floor rinsing.

• All troughs and drains are to be cleared for the next step.

• Visual inspection confirms that this step has been completed satisfactorily.
AVOIDING CROSS CONTAMINATION

DRAINS
- Clean drains before cleaning the rest of the room
- Drain cleaning can create aerosols that can re-contaminate previously cleaned surfaces

AIR HANDLING SYSTEMS
- Very efficient at spreading contamination around your plant
- Cooling coils and air ducts need to be cleaned periodically
Cleaning

- Chemicals are selected for the specific soil, soil adhesion and substrate to be cleaned:
  - Alkaline Cleaners > pH 9 for fats and some proteins
  - Acid Cleaners < pH 2 for mineral deposits and some proteins; have some antimicrobial effect
- Cleaning
  
  - Chemicals are selected for the specific soil, soil adhesion and substrate to be cleaned:
    - Neutral Cleaners for hand scrubbing and for sensitive surfaces and equipment
    - Solvent-Based Cleaners for fats, oils and greases
- Cleaning
  - Cleaning chemicals should always be mixed according to manufacturer’s directions
  - Under-mixing may result in an ineffective and inadequate cleaning job
  - Over-mixing can be dangerous to worker health and is a waste of chemical
Cleaning

- Your chemical supplier is always the best source of information on the selection of the proper chemical for a specific job.
- OSHA requires that plants have an MSDS (Material Safety Data Sheet) for each chemical, readily accessible to all employees.
Cleaning Chemical Application

Many chemical cleaning agents are formulated with a foaming agent for this step.

- Foam additives allow the chemical to cling to the surface being cleaned and keep it from drying out before it has time to work.
- A variety of industrial foaming equipment is available.
Cleaning

- Foamed chemicals are applied with moderate pressure and allowed a sufficient time to work before being thoroughly rinsed off. Some light pressure washing is possible with a foamer.

- Refoaming and hand scrubbing of some surfaces may be necessary to remove soil buildup and to clean hard-to-reach areas and intricate equipment.
- Cleaning

  • A dry surface must be re-foamed before rinsing.
  • Rinse from the top down and from the room perimeter to the drain. Foam should not be visible when thoroughly rinsed.
  • Visually inspect cleaned surfaces and repeat the cleaning step where soil remains.
Produce Cleaning and Sanitation (reference)

- Sanitizers and Sanitizing:
  
  Chlorine

  - Approved for all food contact surfaces

  **Mode of Action:**
  
  - Oxidation of cellular constituents
  - Most effective at low pH

  **Advantages:**
  
  - An inexpensive sanitizer
  - Kills a wide range of bacteria
Sanitizers and Sanitizing:

Chlorine

Disadvantages:
- Efficacy degraded by organic matter
- Corrosive to metals (including stainless steel)
- Poor penetration
- Temperature volatile
- No residual effect

Common Uses:
- 200 ppm as a post-rinse sanitizer
Produce Cleaning and Sanitation (reference)

- Sanitizers and Sanitizing:
  Quaternary Ammonia Compounds, “Quats”
  - Approved for all food contact surfaces

*Mode of Action:*
  - Penetrates cell membranes and inhibits cellular enzymes

*Advantages:*
  - Exhibit good penetration and surfactancy
  - Effective across a broad pH range (pH 2 – 10)
  - Form a bacteriostatic film
  *continued*
- Sanitizers and Sanitizing:
  Quaternary Ammonia Compounds, “Quats”

**Advantages:**
- Stable with some organic matter
- Active at elevated temperatures (180° F to 200° F)
- Relatively non-corrosive and non-irritating

**Disadvantages:**
- Forms a film on equipment
- Can irritate skin at higher concentrations >1000ppm
Sanitizers and Sanitizing:

Quaternary Ammonia Compounds, “Quats”

Common Uses:
- 1000 ppm to disinfect floors and drains
- 200 ppm for food contact surfaces
- Sanitizers and Sanitizing:

  Iodine-Based Sanitizers

  - Approved for all food contact surfaces

  **Mode of Action:**
  - Causes oxidation of cellular constituents
  - Most effective at low pH

  **Advantages:**
  - Kills a wide range of bacteria
  - Good residual protection
  - More effective on viruses than other sanitizers

(continued)
- Sanitizers and Sanitizing:

**Iodine-Based Sanitizers**

*Advantages: (continued)*
- Non-irritating to skin
- Prevents accumulation of mineral deposits

*Disadvantages:*
- Can stain at very high concentrations
- Costs more than Chlorine
- Vaporizes at 43°C (110°F)
- **Sanitizers and Sanitizing:**
  
  **Iodine-Based Sanitizers**

*Common Uses:*
- 25 ppm as a post-rinse and hand sanitizer
- 150 ppm as a disinfectant wash for boots and other non-food contact surfaces
- Sanitizers and Sanitizing:
  
  Peroxyacetic Acid Sanitizers

- Approved for all food-contact surfaces

*Mode of Action:*
- Causes oxidation of cellular constituents

*Advantages:*
- Antimicrobial activity over a wide range of temperatures
- Effective on biofilms and spores
- Tolerant of organic matter
- Environmentally benign residue
Sanitizers and Sanitizing:

Peroxyacetic Acid Sanitizers

**Disadvantages:**

- Mildly corrosive at use concentrations
- Concentrated product requires appropriate PPE
- Product and constituents have low PEL (Permissible Exposure Limit) necessitating appropriate ventilation
- Sanitizers and Sanitizing:

  Peroxyacetic Acid Sanitizers

  **Common Uses:**
  - Suitable as a sanitizer in CIP applications
  - Appropriate as a “Day” sanitizer for belts – 150 ppm maximum
  - Highly effective sanitizer between 85 – 200 ppm
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